

Remarks

In the Office Action September 23, 2002, the Examiner rejected claims 1-4, 6-9 and 18 under 35 U.S.C. § 102 as being anticipated by the U.S. Patent to Mushabac 5,347,454. The Examiner rejected claims 1, 6, 7, 18-22 and 25-30 under 35 U.S.C. § 102 as being anticipated by Thomas, et al. 4,855,565. The Examiner rejected claims 1, 6, 7, 18, 19, 23 and 24 under 35 U.S.C. § 102 as being anticipated by the U.S. Patent to Britnell 5,961,858. The Examiner rejected claims 11-13 and 15-17 under 35 U.S.C. § 103 as being unpatentable over Mushabac. The Examiner rejected claims 5, 10, and 14 under 35 U.S.C. § 103 as being unpatentable over Mushabac in view of Thomas, et al. The Examiner rejected claims 11 and 15-17 under 35 U.S.C. § 103 as being unpatentable over Britnell.

By this response, claims 1-30 have been cancelled and new claims 31-55 are provided to more particularly point out and distinctly claim the subject matter which the Applicants regard as their invention. Accordingly, upon entry of this Reply, new claims 31-55 are pending and reconsideration of this application is respectfully requested.

Original independent claims 1 and 6, are replaced by new independent claim 31. New dependent claims 32-34 replace original claims 3-5, and new dependent claims 35-36 are added and incorporate limitations of deleted original independent claim 6. Original independent claim 11, and original claims 12-17, which depend on claim 11, have been deleted. Original claims 18-30 are replaced by new independent claims 37-38, and new dependent claims 39-40. New method claims 41-55 have been added to further define subject matter which the Applicants regard as their invention.

New independent claim 31 recites a laser device wherein the operating mode of the laser device is sensed to determine a method of crash detection (i.e., what type of alarm or crash signal to generate). During processing, for instance, a "run mode" when the laser head is tracking the surface and processing the workpiece with laser energy, the only time Applicants' device will generate an alarm (or crash) signal is when the cutting head has reached

its extended or retracted physical limit of travel. This is independent of the operation of nozzle tip sensor which is utilized when the laser machine is not processing.

The alarm signals that are based on the nozzle tip sensor are generated when the laser machine is not processing (i.e., head is parked, head is in teach position, or head is in hold position). Also, the alarm level from the sensor is based off the current operating mode of the laser device.

The Mushabac '454 patent does not teach or suggest a sensed operating mode of a laser device to determine a method of crash detection (i.e., what type of alarm or crash signal to generate). Further, the "hold" mode operation is distinguishable from the "interrupt" mode cited by the Examiner from the '454 patent. Referring to page 14, line 28 - page 15, line 2 of the present application, the "hold mode" allows workpiece processing to be performed at a hole or edge location. Further, the "run mode" generally refers to a mode of operation wherein the workpiece is processed with laser energy while the laser head tracks the surface of the workpiece in relation to changing surface topography (i.e., present specification, page 11, lines 3-7, and page 14, line 17 - page 15, line 2). The '454 patent teaches power control of a drill (or other cutting device) so that the cutting tip is energized near engagement. Also, the operation as described in the '454 patent produces an alarm or stops a drill in a manually operated system based on a proximity to a boundary previously defined to a computer during an interactive tooth preparation selection. However, the '454 patent does not teach crash avoidance with a robotically-operated laser head.

The Thomas, et al. '565 patent does not teach or suggest sensing the operating mode of the laser device to determine a method of crash detection (i.e., what type of alarm or crash signal to generate). Also, the structure and operation of "telescopic housing" of the present application is distinguishable from Thomas, et al. Figure 1 of the '565 patent shows a partial perspective view of the work head depicting the work head and axes of rotation. In the '565 patent, column 1, the carrier arm is movable longitudinally, or able to "telescope" to move the work head along the Z-axis. In the present application the laser head is mounted to the robot, and the laser head includes a housing having first and second portions, the first

portion being telescopic with the second body portion, the first body portion being translatable within the second body portion along a common axis. (e.g., Figure 1 of the present application). The gas assist tube of the present application is translatable and within the telescopic housing. Further, the '565 patent does not disclose a structure with an optical fiber to direct a light beam into the housing, a fiber adapter translatable with a receiving optic, designed to maintain a substantially constant distance between the optical fiber and the receiving optic (c.f., Figure 4 of the present application).

The Brinell '858 patent does not teach or suggest using the sensed operating mode of the laser machine to determine what type of alarm or crash signal to generate. Further, though the '858 patent discloses a linear translator axis for movement of the work head along the Z-axis, the laser welding head of the '858 patent does not include a housing having first and second portions, the first portion being telescopic with the second body portion, wherein the first body portion is translatable within the second body portion along a common axis. The '858 patent, primarily directed to a laser welding machine and seam tracking, does not include an adjustable receiving optic to center the focused beam coaxial with a tip. Further, the '858 patent does not disclose a structure with optical fiber to direct a light beam into the housing, a fiber adapter translatable with a receiving optic, designed to maintain a substantially constant distance between the optical fiber and the receiving optic (c.f., Figure 4 of the present application).

Accordingly, new independent claim 31 now includes limitations "means for sensing the operating mode of the laser device to determine a method of crash detection comprising the laser head and nozzle tip sensor cooperating to signal the means for stopping" and means for selecting and communicating the method of crash detection to the means for stopping." Claims 32-36 depend from new independent claim 31.

Original claims 18-30 are replaced by independent claims 37-38 to more clearly define the translatable fiber optic, the telescopic assist gas tube, and corresponding adjustments.

Applicants' Attorney respectfully submits that none of the above-noted references, taken either alone or in combination, teach or suggest the invention as defined by the new independent claims 31, 37 and 38. New claims 32-36 are patentable over the prior art for the same reason that claim 31, from which claims 32-36 depend, is patentable. Also, new claims 39-40 are patentable over the prior art for the same reason that claim 38, from which claims 39-40 depends, is patentable.

Therefore, Applicants submit that the Examiner's rejections of the claims are respectfully traversed and overcome.

New method claims 41-55 have been added to more particularly point out and distinctly claim what Applicants regard as their invention.

Although numerous device limitations are known, as identified by the Examiner, new method claims 41-55 are patentable over the prior art of record as a method of operating a robotic device so as to avoid a crash with a workpiece, fixture or other structure, or to avoid defective laser machining.

Support for the method claims can be found at least in the following sections of the present application: Figure 5, page 3, lines 11-17; page 16, lines 10-13; page 5, line 3; page 6, line 2; page 11, lines 8-17; page 14, line 11; and page 16, line 30.

By way of the attached Information Disclosure Statement, additional references cited in the International Search Report and elsewhere are hereby submitted. In the interest of expediting prosecution of the present application, Applicant wishes to distinguish the new claims over at least some of the new references.

The Kurosawa, et al. '120 patent describes a means of controlling a laser process with optical feedback from the laser radiation on the workpiece. This optical feedback is also referenced as being used to determine the laser machining state. The Kurosawa

reference determines the laser machining state. This is equivalent to the operating mode as defined in the Applicants' disclosure.

The Sugawara, et al. '318 patent teaches prevention of the false alarm signals that are generated from the sensor while processing on the workpiece. In fact, Sugawara, et al. teaches away from Applicants' invention. Instead, Applicants' device uses the sensed operating mode of the laser device to determine a method of crash detection (i.e., what type of alarm or crash signal to generate).

None of the other references including Gilles (French PN 268,954) and Hohberg (USPN 4,707,596) teach or fairly suggest the invention as claimed.

Consequently, in view of the above and in the absence of better art, Applicants' Attorney respectfully submits the application is in condition for allowance which allowance is respectfully requested.

A check in the amount of \$930.00 is enclosed to cover the Petition fee. No additional fee should be required for this Amendment. However, please charge any additional fees or credit any overpayments as a result of the filing of this paper to our Deposit Account No. 02-3978 -- a duplicate of this paper is enclosed for that purpose.

Respectfully submitted,

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Attachment

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Atty Dkt No. GSIL 0189 PUSA Formerly LUM-100-A-PCT-USA

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In The Specification

This [is a completion] application claims the benefit of a co-pending, prior filed U.S. provisional application S.N. 60/099,547 entitled "Laser Cutting-Head with Adjustable Light Source, Crash Avoidance System and Improved Gas Delivery System" filed September 9, 1998, the disclosure of which is herein incorporated by reference.